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CURRENT RESEARCH

on

Improving the Human Environment in the Urban-Forest Interface of the Northeast

A Review for

THE CONSORTIUM FOR ENVIRONMENTAL FORESTRY STUDIES

Prepared by

INSTITUTE OF NATURAL AND ENVIRONMENTAL RESOURCES

UNIVERSITY OF NEW HAMPSHIRE

in cooperation with

THE NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

and the

NORTHEASTERN FOREST EXPERIMENT STATION OF THE U. S. FOREST SERVICE

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FORWARD

This compendium of current research efforts and needs, has been compiled primarily to assist the officials and research scientists operating in the Consortium for Environmental Forestry of the Gifford-Pinchot Institute. The purpose of this compendium is to so guide research planning as to minimize duplication, to encourage "taking the next step", and to economize on research effort by highlighting existing projects and locations where major work is going on, and the scientists making major contributions. The further purpose is to suggest where research may be necessary to adapt basic or other research from other sections of the country or the world to conditions in the northeastern megalopolitan area of the United States. For these reasons, the compilation does not seek to be comprehensive or historic in the problem-area categories listed, but rather to focus on the present and the future.

A large number of information retrieval services have been consulted. In addition, a number of people have gleaned information from libraries and personal sources on the campus of the University of New Hampshire. Because of limited time for the search, it is admittedly uneven. Nevertheless, the results are highly indicative of the major locations and types of research being done at the present time in the United States on forestry in relation to urban areas. It is felt that research direction in these 17 categories will be improved by study of this document over what it could have been with an unguided allocation of funds to research effort.

The organization is by seventeen problem-area categories listed in the Table of Contents. In each category the following sections are outlined:

A. Keyword Listing. This is intended not to be comprehensive but to be suggestive of the areas of concern which the title covers, no title ever being adequate to this purpose.

B. Current Research Projects. This is the major purpose of the compendium - to highlight existing research efforts, experienced scientists, and the centers of research concentration. Primary dependence here was on SIE and CRIS retrieval with some buttressing through examination of Northeastern Forest Experiment Station Project Outlines.

C. Literature Citation. These are meant to be merely indicative or suggestive rather than comprehensive. Again, the effort is to suggest people and locations and to focus on innovative and forward-thinking information sources.

D. Researchable Problems. This listing is intended to serve as a takeoff platform for scientists as individuals or groups considering research efforts and proposals for the Consortium. The listing can, of course, not be exhaustive. Rather it tries to focus on ideas of particular challenge and prospective productivity. For this reason, large areas in which extensive research has been done, for example, insect and disease problems of trees, have been largely omitted. Frankly, the effort is to stiumulate thought. It is hoped that it can give some guidance to officials of the Consortium and others who must endeavor to allocate limited resources to the most critical needs for urban forestry programs.

Sources for ideas on the researchable problems have been primarily Dr. David Olson and the editor. However, two other important sources were carefully examined. The first is the article by Dr. Warren T. Doolittle, "Research in Urban Forestry" in an issue of the Journal of Forestry. The other is the article by Arnold D. Rhodes, "Research Needs in Urban Related Environmental Forestry" contained in the monograph "Trees and Forests in an Urbanizing Environment", published by the Cooperative Extension Service of the University of Massachusetts, as Planning and Resource Document No. 17.

Any researcher desiring more complete information on any listed research project is encouraged to contact the project leader directly, but a complete citation of source used here will be provided upon request.

Otis F. Hall
Editor

ACKNOWLEDGEMENTS

Major contributions to this effort were made by Dr. David P. Olson, who spent one and a half months examining and organizing literature and trying to focus on research needs in this area. Literature Research Institute, Mast Road, Durham, New Hampshire, provided information retrieval search for the major contribution on current research projects and provided a valuable literature survey. Andrew Haaland, a student at the University of New Hampshire in Forestry, provided some initial literature search in the readily available catalogues and peridicals in the library of the University of New Hampshire.

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1. TREE CULTURE TECHNIQUES

A. Keywords: Planting, Fertilization, Prunning, Propagation, Arboreta, Test Plantings, Growth Control, Weed Control.

B. Current Research Projects:

Improving the Human Environment with Trees. S. Little. Northeast Forest and Range Experiment Station, Upper Darby, Pa. Establishment methods, loblolly pine and shortleaf pine. Pitch pine.

Trees for Street and Highway Planting. R. G. Mower. State University of New York, Ithaca, New York. Performance of 54 species in test street plantings.

Management and Evaluation of Plants for Hedges, Screens and Windbreaks. H. Vandewerken. Agricultural Experiment Station, University of Tennesee, Knoxville, Tennessee. Chlorflurenol limits shoot growth in screening shrubbery planting.

Evaluation of Ornamental Plants. E. R. Orton, Jr. Rutgers University, New Brunswick, N. J.

Weed Control in Florists and Nursery Crops and Landscape Plantings. A. Bing. Cornell University, Ithaca, N. Y.

Nutrition and Management of Woodland Trees of Ornamental Value. C. W. Dunham, University of Delaware, Newark, Delaware.

C. Literature Citations:

Bartlett, F. A., 1968. Street Tree Study for the District of Columbia, Tree Expert Co., Stamford, Connecticut. Significant factors that cause deterioration and death of street trees. September, 277 p.

Murphy, L. M., 1963. Plant Species Survival on Landscape Planting Projects, Minnesota Department of Highways, Bureau of Public Roads. Survival on 36 Contract planting projects throughout the State.

Reisch, K. W., 1970. Characteristics and Adaptability of Species and Cultivars of Shade and Ornamental Trees With Emphasis on Street and Highway Landscape Use. Arborit's News, No. 3, pp 24-27. 69 species and cultivars. The Evaluation of existing street trees in five Ohio cities.

D. Researchable Problems:

1. What special techniques of tree planting, such as, potting, balling, special irrigation and aeration, etc., can be developed to plant trees in adverse city locations?

2. Can improved methods of vegetative propagation of woody plants be developed for hard-to-propagate trees well suited for city conditions?

3. How should relative reflectance of radiant energy of different tree species be measured and entered into tree-rating systems for urban planting?

4. Could a survey of urban parks, arboreta, and private dwellings pick out exotic introductions of trees and woody plants that have been successful?

5. What soil improvement and amelioration practices can be successful in revegetation and planting on cleared lots in the city where buildings, roadways, and paving, have been removed to create an open space?

2. BIOLOGICAL ENEMIES OF TREE GROWTH

A. Keywords: Diseases, Pathology, Insects, Site, Soil suitability, Salt, Gas leakage, Soil pollution, Heavy metals, Pesticides, Systemics, Pheromones

B. Current Research Projects:

Accumulation of Heavy Metals in Plants Near Low and High Traffic Densities. R. Reinert. U. S. Environmental Protection Agency, Air Pollution Control Office, Durham, N. C. Heavy metals from automobiles.

Effect of Natural Gas on Soil Eco-Systems in an Urban Environment A. S. Heagle. U. S. Environmental Protection Agency, Air Pollution Control Office, Durham, N. C.

Dutch Elm Disease and Its Control. E. B. Smalley. Agricultural Experiment Station, University of Wisconsin, Madison, Wisconsin. Systemic fungicidal treatment.

Biology and Control of Insects and Mites Affecting Ornamental Trees and Shrubs. T. W. Kerr, University of Rhode Island, Kingston, R. I. Systemic insecticides, methods of application.

Dutch Elm Disease. J. H. Hart. Agricultural Experiment Station, Michigan State University, East Lansing, Michigan. Systemics (methoxychlor and Benlate) evaluation. Predatory insect control.

Dutch Elm Disease Control. F. Howard. Agricultural Experiment Station, University of Rhode Island, Kingston, Rhode Island. Systemic (hydraulic and impact application).

Nature and Control of Dutch Elm Disease and Other Diseases of Shade Trees. L. R. Schreiber. USDA, Shade & Ornamental Plants Lab., Delaware, Ohio. Benomyl as fungicidal treatment.

Pathology of Wilt Diseases of Trees. F. W. Holmes. Agricultural Experiment Station, University of Massachusetts, Amherst, Mass. Physiology of disease resistance in elms.

Etiology of Maple Tree Decline in Massachusetts. W. M. Banfield. Agricultural Experiment Station, University of Massachusetts, Amherst, Mass.

Parasites, Predators, and Host Plant Resistance Studies of the Dutch Elm Disease. J. W. Butcher. Agricultural Experiment Station, Michigan State University, East Lansing, Michigan. Parasites and predators from Europe.

Nature and Control of Diseases of Ornamental Plants and Turfgrasses. H. B. Couch. Virginia Polytechnical Institute, Blacksburg, Virginia. Benomyl and thiabendazole controlled Dutch elm disease.

Biology and Control of Insect Pests of Shade Trees in Northeastern U.S. A. C. Lincoln. N. E. Forest Experiment Station, Delaware, Ohio. Systemic (methoxychlor) for elm bark beetles, pheromones.

Landscape Ecology and Stress Physiology of Plants. F. O. Lanphear. Purdue University, Lafayette, Indiana. Environmental factors stressing plants.

Chemical Control of Insects of Eastern Forest Trees. E. H. Wollerman. Northeastern Forest Experiment Station, Delaware, Ohio.

C. Literature Citations:

Camp, J. V., Dec. 1970. Protecting Trees From Physical Damage on Construction Sites. Aborist's News, Vol. 35, No. 12, pp 129-132. An "air-conditioning" system can be built around the root zone of a tree which is to be saved.

McKenzie, Malcolm A., 1970. Protecting Urban and Suburban Woodlands and Trees from Insects and Diseases. In proceedings of Symposium on Trees and Forests in an Urbanizing Environment, University of Massachusetts, Cooperative Extension Service, August.

Powers, Harry D., 1971. Tree Diseases in An Urban Environment. In proceedings of Symposium on Role of Trees in South's Urban Environment University of Georgia, School of Forest Resources.

Roberts, B. R., April 1970. Environmental Stresses on Urban Trees. Arborists News, 35(4): 33-42.

Wilson, C. L., Feb. 1970. What We Don't Know About Some Shade Tree Diseases. Arborists News 35(2): 9-14.

D. Researchable Problems:

1. Can diagnostic methods be sharpened to better determine the cause or causes of poor health in city trees?

2. Can remedial methods (fertilization, watering, aeration, foliar fertilization, etc.), be better associated with particular necrotic conditions which they will relieve?

3. Are there special non-chemical control methods (or non-contaminating pesticide methods) that are usable on individual trees or isolated stands in cities that would not be effective or too expensive for large forest stands?

4. What are the causes of tree declines, and dieback of crowns, with relation to air pollution and other environmental stress?

5. What is the condition and size of tree-root system under compacted soil or pavements of various sorts.

3. AIR QUALITY IMPACT ON TREES

A. Keywords: Ozone, Sulfur dioxide, PAN, Carbon monoxide, carbon dioxide, Air purification

B. Current Research Projects:

Effects of Air Pollution on a Forest Ecosystem. T. H. Nash. Health, Education and Welfare, Public Health Service, Rutgers University New Brunswick, New Jersey. Zinc and SO_2 in Lehigh Water Gap.

Biochemistry of Ozone Injury to Pines. R. L. Barnes. Health, Education & Welfare. Duke University, Durham, N. C. Physiology of ozone on white and loblally pine.

Shade Tree Improvement Through Breeding and Selection. A. M. Townsend. USDA, Shade & Ornamental Plants Lab. Delaware, Ohio. Uptake of gaseous and particulate contaminants by leaves.

Relationship of Air Pollution to Hardwood Forests of the Northeastern United States. L. S. Dochinger. USDA. N. E. Forest Experiment Station, Delaware, Ohio.

Ozone Damage to Plants. S. Rich. Connecticut State Government. Agricultural Experiment Station, University of Connecticut, Storrs, Conn. Variation and intensity of ozone concentration. Sources.

Landscape Ecology and Stress Physiology of Plants. F. O. Lanphear. Agricultural Experiment Station, Purdue University, Lafayette, Indiana. Ozone injury to woody plants.

Effects on Forest Trees of Long-Term Exposure to Low Concentrations of Air Pollutants. C. R. Berry. USDA. S.E. Forest Experiment Station, Asheville, North Carolina. White pine as biological air pollution indicator (SO_2, fluorides, oxidents).

Investigations of Injury by Phytotoxic Gases. I. Leone. Rutgers University, New Brunswick, New Jersey. Ozone, SO_2 sampling and concentration.

Effects of Photochemical Air Pollutants on Trees.F. A. Wood. Pennsylvania State University, University Park, Pennsylvania. Peroxyacetyl nitrate and ozone.

Air Pollution Problems in the Northeast. R. J. Campana. University of Maine, Orono, Maine. Air pollution monitoring. White pine as test.

Mathematical Simulators of the Effect of Environment on Forests and Forests on Microenvironment. P. E. Waggoner. Connecticut Agricultural Experiment Station, New Haven, Connecticut. Simulator of purification of ozone - polluted air.

Monitoring and Assay of Phytotoxic Airborne Pesticides and Volatile Pollutants. C. H. Sherwood. Iowa State University, Ames, Iowa.

Incorporation of Carbon Monoxide Into Plant Tissues. M. Schaedle. Syracuse University, Syracuse, New York.

Carbon Monoxide Circulation in Plant Ecosystems. Consortium for Environmental Forestry, Pennsylvania State University, University Park, Pennsylvania.

C. Literature Citations:

Bernatzky, A., 1969. The Importance of Protective Plantations in Lowering Air Pollution.

Chamberlain, A. C., 1970. Interception and Retention of Radioactive Aerosols by Vegetations, Atmospheric Environment 4(1) 57-78.

Darley, E. F., 1969. The Role of Photochemical Air Pollution Vegetation.

Davis, Donald D., 1971. In Proceedings of Symposium on Role of Trees in South's Urban Environment, University of Georgia, School of Forest Resources.

Ender, F., 1969. The Effect of Air Pollution on Animals.

Esposito, John C., 1970. Vanishing Air. Ralph Naders Study Group Report on Air Pollution, Grossman Publishers, New York.

Hansbrough, J. R., 1966. Air Quality and Forestry, AAAS Publication #85, pp. 45-55.

Hepting, G. H., 1964. Damage to Forests from Air Pollution, Junior Forestry, pp 630-634.

Hill, A Clyde and Bennett, J. A., 1970. Inhibition of Apparent Photosynthesis by Nitrogen Oxides Atmospheric Environment 4(341-348),

Krebs, E., 1970. The Forests and Air, (Forest Influences). 81(5) 132-1-3, May, German.

Lampadius, F., 1968. The Importance of Sulphur Dioxide Filtration by Forests From the View of Air Pollution Control. (German) Dresden Technical University, Wiss. Z. 17(2): 503-511.

Ohman, J. H., 1968. Forest and Air Pollution, Southern Lumberman 217 (2704): 232-234. December, 99.81

Raynor, G. S., 1967. Effects of a Forest on Perticulate Dispersion, USAEC Meteorological Information Meeting, Chalk River, Canada.

Rich, Saul, 1970. Effects of Trees and Forests in Reducing Air Pollution. In proceedings of Symposium on trees and forests in an urbanizing environment, University of Massachusetts, Cooperative Extension Service, August.

Rice, P. F., 1970. Plant Life and Air Pollution Garden Journal 20(1): 16-19.

Stuess, H. E., 1961. Fuel Residues and Climate. Bulletin Atomic Scientists, 17:374-75.

Thompson, C. R. and Taylor, O. C., 1969. Effects of Air Pollutants on Growth, Leaf Drop, Fruit Drop and Yield of Citrus Trees. Environmental Science Technology 3(10) 934-940, October.

Veenman, H. and Zonen, N. V., 1969. Air Pollution: Proceedings of the First European Congress on the Influence of Air Pollution on Plants and Animals, pp. 383-395. Wagreningen, The Netherlands.

Guide to Research in Air Pollution Projects Active in Calendar Year 1969. U. S. Government Printing Office, Washington, D.C.

D. Researchable Problems:

1. Should data for better and more complete lists of the relative tolerance of various tree species to different concentrations of different air pollutants be discovered and compiled?

2. To what extent do forests absorb, diffuse, or disperse air pollutants and particles when trees are in screens or strips between industrial and housing areas?

3. What are concentrations and extent of ozone in the atmosphere at particular locations, especially related to sources of ozone?

4. What is the real relationships of forest trees to carbon dioxide concentration both in terms of reducing and increasing growth as a result of it?

5. How do the magnitudes of carbon dioxide renovation to oxygen by forests compare with oceans and grasslands? How do varying levels of CO_2 concentration compare with limits that effect animals and human beings?

4. GENETIC ADAPTATION OF TREES

A. Keywords: Selection, Breeding, Crossing, Disease resistance, Insect resistance.

B. Current Research Projects:

Breeding Trees Resistant to Air Pollutants. H. D. Gerhold. Health, Education & Welfare, Public Health Service, Penn. State University, University Park, Pennsylvania. Ozone and SO_2 resistant scotch pine.

Forest Tree Improvement Through Selection and Breeding. J. W. Wright. Agricultural Experiment Station, Michigan State University, East Lansing, Michigan. Pest resistance of pines and spruces.

Dutch Elm Disease and Its Control. E. B. Smalley. Agricultural Experiment Station, University of Wisconsin, Madison, Wisconsin. Mass screening of elm for Dutch elm disease resistance.

Forest Tree Improvement Through Selection and Breeding. J. J. Jokela. Agricultural Experiment Station, University of Illinois, Urbana, Illinois. Provenance and progeny testing of Acer, Larix, Populus, others.

Shade Tree Improvement Through Breeding and Selection. A. M. Townsend. USDA., Shade & Ornamental Plants Lab., Delaware, Ohio. Resistance elms.

Cytogenetics, Breeding and Evaluation of Shade Trees. F. S. Santamour. USDA., Crops Research Division, Washington, D. C. Inheritance patterns of environmental resistance, elm, sweetgum, metasequoia, magnolias.

Nature and Control of Dutch Elm Disease and Other Diseases of Shade Trees. L. R. Schreiber. USDA, Shade & Ornamental Plants Lab., Delaware, Ohio. Selection, colchicine treatment.

Markers for Dutch Elm Disease - Elm Bark Beetle. W. Sinclair. Allegheny Foundation, State University of New York, School of Forestry, Ithaca, New York. Indication of resistance.

Resistance of Norway and White Spruce to Eastern Spruce Gall Aphid. B. Thielges. Ohio Agricultural Res. and Development Center, Wooster, Ohio. Selection and propagation.

C. Literature Citiations:

Schreiner, Ernst J., 1966. Guidelines for Selecting and Producing Genetically Better Trees for Street and Park Planting. New Jersey Federation Shade Tree Commission Proc.: 38-43.

D. Researchable Problems:

1. Can we extend the number of species for which there are special breeding programs, to reduce susceptability to air pollution?

2. Can some clones of certain species be selectively bred for characteristics such as limited height growth, compact branchiness, heightened color, or low fruit production that make them more attractive in urban planting?

3. Can special selections of conifers be found that are resistant to salt, automobile fumes, etc., because the year-round foliage gives them special desirability along highways, for screens, etc.?

5. NURSERY OPERATION AND MARKETING

A. Keywords: Management, Demand, Costing, Procurement of planting stock, Marketing channels.

B. Current Research Projects:

Woody Ornamental Nursery Industry in Tennessee. W. E. Goble. Agricultural Experiment Station, University of Tennessee, Knoxville, Tennessee. Numbers and types of firms, sales channels to communities and highways.

Development of Mechanized Equipment for the Nursery Industry. K. Q. Stephenson. Agricultural Experiment Station, Penn State University, University Park, Pennsylvania. Digging tool for balled stock designed and tested.

C. Literature Citations:

D. Researchable Problems:

1. Is there need for urban and suburban planting stock which is not being met by commercial nurseries but will require government nursery operations by highway departments and municipal or county street and park systems?

2. Are there greater possibilities of use in nursery operations for mulches from waste wood products or composted plant material and waste products, including chips from logging slash cleanups?

3. What are the mechanisms for introducing genetically improved species for urban planting into the commercial nursery trade?

6. HIGHWAY BORDER VEGETATION

A. Keywords: Maintenance, Mulching, Fertilization, Evaluation.

B. Current Research Projects:

Plants to Increase Highway Safety and Beauty and to Decrease Maintenance Cost and Prevent Erosion. W. D. Holley. Agricultural Experiment Station, Colorado State University, Fort Collins, Colorado. Planting and mulching methods. Wide consideration of functions of highway vegetation.

Native and Introduced Plants for Roadside Planting. H. P. Orr. Agricultural Experiment Station, Auburn University, Auburn, Alabama. Chemical weed control, species testing.

A Systematic Cataloging and Evaluation of Plant Materials for Highway Use in Georgia. F. B. Perry, Jr. University of Georgia, Athens, Georgia.

Roadside Vegetation Investigations. R. C. Wakefield. University of Rhode Island, Kingston, Rhode Island. Control by growth retardant.

A Study of Shrubs and Vines in Roadside Development. C. H. Korns. Mississippi State University, State College, Mississippi. Long term fertilizer tablets tested.

Establishing Persistant Vegetation on Cuts and Fills Along West Virginia Highways. R. E. Blaser. Virginia Polytechnical Institute, Blacksburg, Virginia.

C. Literature Citations:

Brinton, J. H., 1969. Effect of Highway Landscape Development on Nearby Property, Highway Research Board NCHRP Reports. NU 75, 82 pp, 38 Figs., 6 Tabs, 9 Apps. Sound levels and Sound level reductions. Highway Disturbances and landscape/landforms on property values, and their effect.

Duell, R. W., 1969. Highway Vegetation: For Utility, Safety, Economy, and Beauty. Rutgers State University, New Jersey Agricultural Experiment Station, Bulletin 822, 30 pp.

Godfrey, C. E. A Systematic Cataloging and Evaluation of Plant Materials for Highway Use. Georgia University, Georgia State Highway Department, Bureau of Public Roads. 267 species of plants. 102 are trees. Site and climatic requirements.

McInturff, G. F. and Thiel, F. I., 1970. Highway Beautification. Proceedings of 46th International Shade Tree Conference, Rochester, New York, August 13., pp. 51-56.

Neill, J. W. Some Observations on the Ecological Adaptations of Trees. Proceedings from Natural Shade Tree Conference, 1960, 1961 (15-37).

Noyes, John H., 1969. Woodlands, Highways and People. Cooperative Extension Service Publication 33, University of Massachusetts, Amherst, 21 pp.

Schrift Strassenbau and Verkehr, S. T. R., 1968. Landscaping on Highways (in German). No. 69, pp. 54.

D. Researchable Problems:

1. Is there native vegetation or selected strains of forest trees which would be useful for landscape value along highways, or with special attractiveness in power line rights-of-way?

2. Can highway and utility rights-of-way be wider as a means of maintaining more open space and attractiveness through developed areas, giving additional recreational or aesthetically appealing areas?

3. Can highway and utility rights-of-way be furnished with irrigation systems which will use and disseminate secondary effluents and other types of waste water in such a way as to improve growing conditions while also solving a waste-disposal problem?

4. What combinations of highway design (side banking, high-median strips, sunken roadways), and tree plantings are most attractive and aid in traffic separations and driver attention maintenance?

7. ECOLOGY OF INTENSIVELY USED STANDS

A. Keywords: Soil compaction, Nutrient recycling, Ground cover, Rehabilitation.

B. Current Research Projects:

Wild-Land Ecology and Urban Impact. R. E. Jones. Agricultural Experiment Station, University of Delaware, Newark, Delaware. Woodland size, faunal composition, indicator species.

C. Literature Citations:

Braun, E. Lucy, 1950. Deciduons Forests of Eastern North America, Blakiston Co., Philadelphia, P.A., 596 pp.

Collins, Stephen, 1956. The Biotic Communities of Greenbrook Sanctuary. Palisades Nature Association, Englewood, N.J.

Lindsay, D. James, Aug. 1970. Protecting and Managing Trees and Wooded Areas Subjected to Heavy Recreational Use. In proceedings of Symposium on Trees and Forests in an Urbanizing Environment, University of Massachusetts, Cooperative Extension Service.

Odum, Eugene P., 1971. Ecological Principles and the Urban Forest. In proceedings of Symposium on Role of Trees in South's Urban Environment, University of Georgia, School of Forest Resources.

Waggoner, P. E. and Ovington, J. D., 1962. Proceedings of the Lackwood Conference on the Suburban Forest and Ecology, New Haven, Connecticut, Bulletin 652, Connecticut Agricultural Experiment Station, 102 p.

D. Researchable Problems:

1. Can a proper size be designated for a single family city lot which approaches a total system or is ecologically self-sufficient, i.e., purifies the air pollutants produced, absorbs the water which falls on it, and renovates waste materials produced in it, a least liquid waste? Can this principle be applied to neighborhoods, if nearby open spaces such as parks, right-of-ways, etc., are included?

2. What values are there in maintaining a forested (uncleared, non-lawn) area on each city lot, especially areas for water percolation, and organic decomposition such as lawn clippings, leaf rakings, etc.?

3. What is the effect of the negative values in natural forest stands and tree areas in production of irrigating pollens and poisonous shrubs and plants?

4. What is the rate of natural restructuring of disturbed or compacted soils by a forest stand?

5. What successional trends are found in natural forest areas in the city? What are the causes of abnormalities in this succession, and to what extent does the presence of people modify this succession?

6. What is the nutrient cycling process in an urban or sub-urban park compared to an undisturbed stand? Are special management methods necessary to maintain this process?

7. Can natural successional trends be slowed or stopped more cheaply on highway or power line rights- of - way where certain limitations to vegetation are necessary?

8. What is the ecological significance of wetlands and coastal marshes, both by themselves and in relation to surrounding vegetation types.

8. FOREST PRODUCTS - GROWTH AND HARVESTING

A. Keywords: Aesthetic logging, Tree removal, Wood disposal, Metal detection, Urban logging equipment.

B. Current Research Projects:

Suburban Forest Ownership. L. S. Hamilton. Agricultural Experiment Station, State University of New York, Ithaca, New York. Reaction of suburban owners to forest harvesting.

Municipal Watersheds, Urban-Suburban Trees and Environment, and Correlating Watershed Research Results. H. W. Lull. U. S. Department of Agriculture, North East Forest and Range Experiment Station, Upper Darby, Pennsylvania. Timber production on municipal watersheds.

C. Literature Citations:

Huff, P. R. and Craig, J. W., 1968. A New Breed - The City Forest Farmer, Forest Farmer 28(2):25, 44,46. November. 99.8F 7692.

Jones, Phil, 1966. Forest Management in Your Own Back Yard, Connecticut Woodlands 21(5) pp. 3-4.

Kielbaso, J. James, 1971. Economic Values of Trees in the Urban Locale. In proceedings of Symposium on Role of Trees in South's Urban Environment, University of Georgia, School of Forest Resources.

Niehaus, T. B., 1968. Merchantable Timber Values in Recreational Developments, Appraisal J.36(4): 570-575. Oct. 282.8 Am 3.

Phillips, David L., 1970. Waste Wood Disposal- Incineration vs. Utilization Proceedings of 46th International Shade Tree Conference. Rochester, N.Y., August 13, pp. 14=15.

Thornton, Philip L., 1970. Managing Urban and Suburban Trees and Woodlands for Timber Products. In proceedings of Symposium on Trees and Forests in an Urbanizing Environment, University of Massachusetts, Cooperative Extension Service, August.

D. Researchable Problems:

1. What techniques of timber production and harvesting can be developed to minimize adverse impact on landscape values?

2. What special methods are available for reduction and disposal of logging debris, such as chipping, firewood donation? Are there desirable disposal methods of chipping logging slash for mulch, etc.?

3. Can very high value, large trees by a genuine asset managed very intensively on urban properties?

4. What type of extension services or consultant help will be most useful to the urban and suburban woodland owner?

9. WILDLIFE IN URBANIZING ENVIRONMENT

A. Keywords: Birds, Bird watching, Predation, Pesticides, Fishing, Habitat, Appreciative use of wildlife, Spectator enjoyment.

B. Current Research Projects:

Environmental Forestry. Annual Report for Northeastern Forest Experiment Station Research Work Unit, Amherst, Massachusetts.

Wild Shrubs for Possible Use in Habitat Management for Suburban Songbirds. Northeastern Forest Experiment Station, U.S. Forest Service, Pinchot Institute, Delaware State College, Dover, Delaware.

C. Literature Citations:

_____1968. Man and Nature in the City. A Symposium sponsored by the Bureau of Fisheries and Wildlife, U.S. Department of Interior, Superintendent of Documents, U.S. Government Printing Office, 91 p.

Larson, Joseph, S., 1970. Managing Woodlands and Wildlife Habitat in and Near Cities. In proceedings of Symposium on Trees and Forests in an Urbanizing Environment, University of Massachusetts, Cooperative Extension Service, August.

Lime, David W., and Cushwa, Charles T., 1969. Wildlife esthetics and auto campers in the Superior National Forest, N. Central Forest Experiment Station, St. Paul, Minn., 8 p.

Sinton, John W., 1970. The Social Values of Trees and Forests for Recreation and Enjoyment of Wildlife. In proceedings of Symposium on Trees and Forests in an Urbanizing Environment, University of Massachusetts, Cooperative Extension Service, August.

Taylor, H., 1968. Pheasant Hunting 30 Minutes from San Fransisco Soil Conservation 34(3): 56. Oct. 1968. 1.6So3S.

Nature Downtown (1970) Cooperative Project of Sport Fisheries and Wildlife Bureau, National Park Service, Bureau of Outdoor Recreation, and National Zoological Park. Paper.

D. Researchable Problems:

1. What special techniques are available for management of non-game species, such as, song birds, squirrels, chipmunks, rabbits, etc.

2. What conditions most help urban wildlife to protect themselves from special urban predators, such as dogs and cats?

3. How can wildlife appreciation as a spectator be fostered in suburban areas?

4. What obnoxious and harmful animals and insects are fostered by forest areas, such as, mosquitoes, blackbirds, rats, bats, etc., and how can their presence be minimized?

5. What plant species contribute to wildlife habitat distribution and food in the suburban fringes?

6. What mixtures of conditions, grasslands, forest, shrubbery, etc., are most conducive to animal populations in suburban areas?

7. What sizes of forested areas are necessary in suburban areas, considering the range and cover requirements of various species?

10. WATER PRODUCTION AND CONTROL

A. Keywords: Runoff, Storm runoff, Sedimentation, Contamination, Water supply, Municipal Watershed, Infiltration, Water yield,

B. Current Research Projects:

Municipal Watersheds, Urban-Suburban Trees and Environment, and Correlating Watershed Research Results. H. W. Lull. U. S. Department of Agriculture, N. E. Forest and Range Experiment Station, Upper Darby, Pennsylvania. Water yield increases thru Forest Treatment.

Effects of Different Forest Types and Conditions on Stream Regimen and Water Yields. Annual Report for Northeastern Forest Experiment Station Research Work, Syracuse, N.Y.

Municipal Watersheds, Urban-Suburban Trees and Environment, and Correlating Watershed Research Results. Annual Report for Northeastern Forest Experiment Station Research Work, Upper Darby, Pennsylvania.

C. Literature Citations:

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Hornbeck, James, 1968. Protecting Water Quality During and After Clearcutting. Journal Soil and Water Conservation 23(1): 19-20. With adequate attention to logging roads, eastern hardwoods can be clearcut with little harm to the water resources.

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Lull, Howard W., 1970. Effects of Trees and Forests on Water Relations. In proceedings of Symposium on Trees and Forests in an Urbanizing Environment, University of Massachusetts, Cooperative Extension Service, August.

Pierce, Robert S., 1967. Water-Quality Problems Related to Timber Culture and Harvesting. University of Massachusetts, Cooperative Extension Service, Publication 446, 45-48 (Municipal Watershed Management Symposium Proceedings, 1965.)

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Reigner, Irvin C., Sopper, William E., and Johnson, Roy R., 1968. Will the use of 2,4,5T to control streamside vegetation contaminate public water supplies? Journal Forestry 66: 914-918.

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Tomiczek, H., The Forest As a Reservoir of Water For Metropolis Allg. Forstzeitung 81(5):138-139 May 1970 German.

Wilm, H. G., 1970. Managing Trees and Woodlands to Protect and Improve Water Supplies. In proceedings of Symposium on Trees and Forests in an Urbanizing Environment, University of Mass., Cooperative Extension Service, August.

D. Researchable Problems:

1. How can the New England Mill Pond be made a greater center of Wildlife attractiveness and outdoor interest in the communities where they occur?

2. What forest stand practices to maximize income, minimize cost, and get the greatest values of all sorts are there for flood plains and edges of water courses which should keep out of development for hydrologic and flood-damage prevention reasons?

3. Can building lot, business area, and park and highway areas be better designed to maximize infiltration, provide adequate moisture for trees and shrubs growing on them, and decrease runoff and accompanying damage? Can incentives be provided for such planning?

4. Can soil structure improvements be made to increase percolation into soils in disturbed areas? What special disposition should be made for controlling snow melt in park and city lots to maximize water yield? What is the pattern of storm runoff from paved areas and other special urban surfaces?

5. Is urban runoff water harmful or helpful to plants? Does it contain pollutants (salt, herbicides, insecticides, etc.) and so needs special disposition? Can special grading and design features be brought into parks, highways, etc., to provide water spreading and distribution?

6. Can more intensive management methods on networks of municipal watersheds provide better runoff control and larger quantities of water?

11. WASTE RECYCLING THROUGH FOREST ENVIRONMENTS

A. Keywords: Waste water, Nutrient removal, sewage treatment, Industrial water, Thermal water, Solid waste, Landfill, Phosphorus removal.

B. Current Research Projects:

Disposal of Paper Mill Effluent Through Irrigation of Bottomland Hardwood Under Louisiana Conditions. C. W. Wilson. School of Agriculture, Louisiana Polytechnical Institute, Ruston, Louisiana. A System for delivery of the waste water to the forest area to be irrigated will be designed.

Revegetation of Bituminous Coal Strip Mine Spoil Banks With Municipal Waste Water and Liquid digested sludge, Phase II. W. E. Sopper. To compare vegetation survival and growth response to various years of treatment.

Ecological and Physiological Implications of Greenbelt Irrigation, Stage III. Dr. V. B. Youngner. School of Agriculture, University of California, Riverside, California. The effects of the changed environment on introduced grasses, forbs, shrubs, and trees is being observed.

Using Cropland For Sewage Wastewater and Sludge Disposal. L. T. Kardos. Agricultural Experiment Station, Penn. State University, University Park, Pennsylvania. Interaction of soils and plants with sewage wastewater and sludge disposed on cropland and forestland.

Conservation and Renovation of Waste Water. L. T. Kardos. Agricultural Experiment Station, Penn. State University, University Park, Pennsylvania. Determine to what extent agronomic crops, trees, and soil mantle can renovate sewage plants effluent.

Processing Plant Effluents for Irrigation in Coastal Plains of North-East. G. A. Pearson. USDA, Soil and Water Department, Norfolk, Virginia. Tangential significance, by indicating that bare soil becomes sealed against percolation faster than woodland or grassland.

An Experimental Program on Water Quality Management. Rockefeller Foundation. Michigan State University, East Lansing, Michigan. A series of lakes and ponds. Water, in various stages of purification will feed areas planted with trees, grass, crops, and garden plants.

A Stripmine Reclamation Project. Shawnee National Forest Service, Palzo, Illinois. Sewage from the city of Chicago have been applied to a quarter-acre test plot.

Effect of Sewage Effluent On The Soil Chemical Status. Consortium for Environmental Forestry, Pennsylvania State University, University Park, Pennsylvania.

C. Literature Citations:

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Bendixen, T. W., Hill, R. D., Schwartz, W. A., and Robeck, G. G., 1968. Ridge and Furrow Liquid Waste Disposal in a Northern Latitude. American Society of Civil Engineers. Disposal of effluent from a two-stage high-rate biological filtration plant at Westby, Wis. Even under adverse winter conditions additional purification of filter effluent is achieved. A high degree of nutrient removal.

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Brisbin, Robert L., 1969. Influence of Sewage Effluent Irrigation on Physical and Mechanical Properties of Plantation Growth Red Pine. Thesis, Pennsylvania State University, University Park, Pennsylvania.

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Kardos, L. T., 1967. Waste Water Renovation by the Land - A Living Filter. In agriculture and the quality of our environment. American Association for the Advancement of Science, Monograph No. 85.

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Little, S. H., H. W. Lull, and I. Remson, 1959. Change in Woodland Vegetation and Soils After Spraying Large Amounts of Wastewater. Forest Science, Vol. 5:18-27.

Meyers, Earl A., 1966. Waste Water Conservation and Renovation Research, Pennsylvania State University, University Park. December.

Parmele, L. H., 1964. A Comparison and Evaluation of Methods for Distributing Waste Water in Wooded Areas. M.S. Thesis, Department of Agricultural Engineering, The Pennsylvania State University, University Park, Pennsylvania.

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Peters, J. H. and Rose, J. L., 1968. Water Conservation by Reclamation and Recharge. To serve the growing needs of Nassau County, Long Island, NY. Treatment of sewage works effluent before use for recharge.

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Sopper, William E., 1968. Effects of Sewage Effluent Irrigation on Tree Growth. Pennsylvania State University. Significant increases in the growth of mixed oak stands and white spruce.

Thomas, R. E., 1970. Industrial Waste Irrigation. American Society of Civil Engineers, Proc. 96.

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Wilson, Charles W. and Cantrell, Robert P., 1968. A Study of the Technical and Economic Feasibility of Using Sewage Effluent for Irrigation in Lincoln Parish, Louisiana. Louisiana Polytechnic Institute, Ruston, Department of Agricultural Engineering.

D. Researchable Problems:

1. How can forest lands in the vicinity of animal agricultural establishments in urbanizing areas be used to minimize animal waste pollution sources?

2. How can the findings of the Penn State Research work be made more widely applicable in more urban conditions of the Northeast?

3. Can lakeside forest lands by used as a filter to strip nutrients from eutropic lakes?

4. What special revegetation methods are necessary for completed landfill areas?

5. What possibilities exist for mulch disposal of ground paper and plastics in forest areas? Can wood waste and sewage sludge mixtures be used to accelerate detoxification and be later distributed in forest areas? Can solid waste (composted sludge, waste wood, bark) distribution on forest lands be coordinated with stages in forest management, e.g., as mulches for weed control in plantations?

12. RECREATIONAL USE OF URBANIZING FOREST LAND

A. Keywords: Demand, Access, Parks, Vandalism, Nature trails, Outdoor edcuation.

B. Current Research Projects:

Recreational Use of Natural Resources. H. Johnson. USDA, Natural Resource Economics Division, Washington, D.C. Required for successful recreation enterprises. Evaluate both public and private programs for improving the natural beauty. Estimating the outdoor recreation demand for metropolitan areas. Fee fishing lakes in Pennsylvania generally return low incomes.

Consumer Forest-Oriented Recreation Activities. M. I. Bevins. Agricultural Experiment Station, University of Vermont, Burlington, Vermont. Forest oriented recreation, hunting and fishing.

Forest Recreation Demand and Cooperative Forest Recreation Research. E. L. Shafer. School of Forestry, State University of New York, Syracuse, New York. Leisure behavior patterns.

The Nature of Urban Recreation on the Public Forests of Utah's Wasatch Front. R. A. Ogle. Utah State University, Logan, Utah. Demands of Urban users.

Depreciative Behavior in Outdoor Recreation. F. Campbell. University of Washington, Seattle, Washington.

Ecological Aspects of Outdoor Recreation Planning and Development. J. R. McBride. Iowa State University, Ames, Iowa. Measuring recreational carrying capacity.

A Supplemental Progress Report for CRIS. James C. Whittaker. Opportunities for leasing private woodlands for recreation.

The Potential Role of Easements in Expanding Opportunities for Urban people to Enjoy More Recreation. Consortium for Environmental Forestry. University of Connecticut, Storrs, Connecticut.

Recreation Participation Patterns Across an Urban-Suburban-Rural Spectrum. Northeastern Forest Experiment Station, U.S. Forest Service. College of Forestry, Syracuse, N.Y. To better forecast demand and shifts in recreation preferences.

C. Literature Citiations:

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Wilkins, B. T., 1969. Community Planning For Outdoor Recreation, New York's Food and Life Sciences, Vol. 2, No. 3, July-Sept., pp 6-8.

Whittaker, James C., 1968. Landleasing--an aid to developing outdoor recreation enterprises in Indiana, Kentucky, and Ohio. U.S. Forest Service Res. Paper, NE-113. Leasing areas to hunting-shooting groups. Areas near a large city or that have water recreation facilities have lease-marketing possibilities.

D. Researchable Problems:

1. Are there ways to link woodland trail systems to urban centers so that the inner city dweller need not have personal transportation to reach them, e.g., trails along rights-of-way for utilities, railroads, and highways?
2. Can smaller scattered city parks contain well maintained and designated aboreta which can be used for study by students in high schools and other schools and so give an earlier appreciation of forest growth and the out of doors; perhaps minimizing vandalism problems?

3. Can larger variety of land-use preactices be initiated in urban and suburban parks, increasing interst and appreciation of these areas?

4. Can greater exclusion of automobile access, but increased accessibility to bicycles or possibly horses in suburban parks, increase the "diverse" use value of limited areas?

5. Can private enterprise be encouraged to develop recreational opportunities in the out of doors in urbanizing areas faster than is feasible, financially or socially, through public land acquisition?

13. AMENITY VALUES OF URBAN TREES AND FORESTS

A. Keywords: Shade, Temperature control, Screening, Windbreaking, Snow control, Noise absorption.

B. Current Research Projects:

Forest Recreation--The Values Placed on Trees for Recreation Environment. F. H. Forsyth. Agricultural Experiment Station University of Maryland, College Park, Maryland. Tree functions - windbreak, shade, bird study.

Landscape Ecology and Stress Physiology of Plants. F. O. Lanphear. Agricultural Experiment Station, Purdue University, Lafayette, Indinana. Describes reduction by evergreen plantings.

Effects of Different Forest Types and Conditions on Stream Regimen and Water Yields. R. E. Leonard. School of Forestry, State University of New York, Syracuse, New York. Conifer forest reduces incident radiation; noise abatement of pine plantations.

Efficacy of Trees and Wooded Areas in Reducing Noise Levels. Northeastern Experiment Station, U.S. Forest Service, College of Forestry, State University of New York, Syracuse, N.Y.

C. Literature Citations:

Aylor, Donald E., 1971. How Plants and Soil Muffle Noise. Frontiers of Plant Science, Connecticut Agricultural Experiment Station, New Haven, Connecticut. (May).

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Beck, G., 1968. Plants as aids in Noise Abatement. Patzer-Verlag, Hanover. pp. 95.

Cook, David I and VanHaverbeke, David F., 1970. Trees and Shrubs for Noise Abatement. In proceedings of Symposium on Trees and Forests in an Urbanizing Environment, University of Massachusetts, Cooperative Extension Service, August.

Federer, C. A., 1970. Effects of Trees in Modifying Urban Microclimate. In proceedings of Symposium on Trees and Forests in an Urbanizing Environment, University of Massachusetts, Cooperative Extension Service, August.

Gray, Betty D., 1971. The Role of Trees as Producers of Allergenic Pollens. In proceedings of Symposium on Role of Trees in South's Urban Environment, University of Georgia, School of Forest Resources.

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Knoerr, Kenneth, R. 1971. The Role of Trees in Modifying Microclimate. In proceedings of Symposium on Role of Trees in South's Urban Environment, University of Georgia, School of Forest Resources.

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McKenzie, M. A., 1970. Role of a Shade Tree in Urban Forestry. Arborists News 35(3): 21-24, March.

Meroney, R. N., 1970. Wind Tunnel Studies of the Air Flow and Gaseous Plume Diffusion in the Leading Edge and Downstream Regions of a Model Forest. Atmospheric Environment 4(597-614)

Seito, T., 1964. On the Wind Profiles in Plan Communities. Bulletin, Natural Institutue Agriculture Science (Japan) Series A., No. 11.

Siekman, William, 1969. Outdoor Acoustical Treatment: Grass and Trees. Journal Acoustical Society of America 46(No. 4, part 1) pp 863-864. (Work at Riverbank Acoustical Laboratory I.I.T. Research Institute, Geneva, Illinois, on grass and balsam fir, cut.)

D. Researchable Problems:

1. Can research increase the understanding of trees and forests in transforming solar energy into latent energy through evapotranspiration?

2. Are there decernible effects of large forested areas in cities on "climate"?

3. Can the presence of trees have sufficient cooling effect in summer to reduce electricity consumption for air conditioners?

4. What is the magnitude of the benefits to housing in forested conditions through higher real estate prices, lower insurance rates, less damage from vandalism, etc.?

5. If there a minimum size of forest stand necessary to have an appreciable effect on microclimate conditions?

6. To what extent does the urban population in its various segments recognize the amenity values of forests which we claim for it?

7. Can forests in suburban areas be correlated with airport approach paths to reduce adverse noise effect?

8. What effects have forested zones on wind patterns and the related benefits or harmful effects of these wind patterns?

9. What effect can forested strips of various widths have on odor carried by wind currents?

10. What species mixtures, and arrangements of plants are most effective, least costly, and easiest to maintain for screening effects (see prarie windbreak research)?

11. What benefits are there physilogically and physically to users of mass transit systems from vegetative screening of these channels of transportation?

14. AESTHETIC IMPROVEMENT THROUGH TREES AND FORESTS

A. Keywords: Landscaping, Visual images, Perception, Beauty, Design,

B. Current Research Projects:

Forest Recreation Demand and Cooperative Forest Recreation Research. E. L. Shafer. School of Forestry, State University of New York, Syracuse, N.Y. Visual perception of selectively cut stands and uncut stands.

Computer Applications in Landscape Architecture. C. F. Gerlach. Purdue University, Lafayette, Indiana. Use in site and land planning.

Environmental Forestry. Brian R. Payne. Annual Report for Northeastern Forest Experiment Station Research Work Unit. Amherst, Massachusetts. Criteria for judging aesthetic value of forest resources.

Problems of Landscape Tending in Densely Populated Areas. Northeastern Forest Experiment Station, U.S. Forest Service, University of Massachusetts, Amherst, Massachusetts.

How Landscaping Patterns and the Presence of Trees Raise the Dollar Value of Real Estate. Northeastern Forest Experiment Station, U.S. Forest Service, University of Massachusetts, Amherst, Massachusetts.

C. Literature Citations:

Cornell, R. D., 1965. Designing with Trees, Landscape Arch. 56:70-1 0 .

Miles, Roger, 1970. Effects of Trees and Forests in Landscape Aesthetics. In proceedings of Symposium on Trees and Forests in an Urbanizing Environment, University of Massachusetts, Cooperative Extesnion Service, August.

Noyes, John H., 1970. Managing Trees and Woodlands to Improve the Aesthetics of Communities. In proceedings of Symposium on Trees and Forests in an Urbanizing Environment, University of Massachusetts, Cooperative Extension Service, August.

Owens, Hubert B., 1971. Selecting Trees for Environmental Compatibility and Aesthetic Appeal. In proceedings of Symposium on Role of Trees in South's Urban Environment, University of Georgia, School of Forest Resources.

Petch, A. M., 1967. Creating An Urban Treescape. Quart. Journal of Forestry, 61 (1), (51-8).

Shafer, Elwood L., Jr., 1967. Forest Aesthetics--A Focal Point in Multiple-Use Management and Research. 14th IUFRO Congress Papers 7, Sect. 26: 47-71, illus. Munich, Germany. Need for imaginative programs and innovations designed to enhance the aesthetic values of forest stands that are being intensively managed for pulpwood and timber production.

Smith, Herrick H., 1971. The Role of Trees in Landscape Aesthetics. In proceedings of Symposium on Role of Trees in South's Urban Environment, University of Georgia, School of Forest Resources.

Wood, C. E., 1968. St. Pauls Downtown Tree-Planting Plan, Landscape Arch. 58:312-14 Jl.

D. Researchable Problems:

1. What silvicultural systems should be used in a forest area that is being maintained primarily, or even exclusively, for its aesthetic values? Is the undisturbed forest the most aesthetically pleasing?

2. What inexpensive methods are available for maintaining the attractive appearance of open understory areas and vistas through or beneath forest stands?

3. What landscaping methods are best for screening refuse dumps, borrow pits, etc.?

4. Can highly anylytical methods (eye movement tracing, etc.) be used for isolating the qualities that make a landscape attractive or interesting?

5. What is the response of urban or suburban dwellers to various types of wildland, such as high forest, brush, grass, water, open space vistas, etc.? Can this response be graded? Can differences be found for people who live in central city versus suburbia versus rural people? What effect has a specific educational program about forest land appreciation on this response. Where does "Wilderness" area appreciation fit into this spectrum?

6. What is the importance of variability in landscape appearance on urban and suburban dwellers? Does the attainment of variability through planned landscape manipulation justify the efforts in that direction? Can activity patterns for people engaged in recreation, leisure, and sightseeing be influenced by landscape design?

15. SOCIAL AND PSYCHOLOGICAL ATTITUDES TOWARD OUTDOOR ENVIRONMENT

A. Keywords: Culture, Fear, Conservation values.

B. Current Research Projects:

Socio-Environmental Relationships Between Pineview Reservoir, Cache National Forest and the Residents of Metrolpolitan Weber County, Utah. J. J. Lindsay. School of Agriculture, Utah State University, Logan, Utah.

Relationships Between Recreation Land Management and user Satisfaction. L. C. Merriam, Agriculture Experiment Station, University of Minnesota, Saint Paul, Minnesota. Imagery of users, family cohesiveness, manager-user differences.

Performance Traits of Forest Recreationists. W. T. Moss. Agricultural Experiment Station, University of Georgia, Athens, Georgia. Personal and family background, influences, participant behavior.

Development of Rhode Island Forested Lands. C. Gratto. Agriculture Experiment Station, University of Rhode Island, Kingston, Rhode Island. Owner attitudes toward their holdings.

Forest Recreation--The Values Placed on Trees for Recreation Environment. F. H. Forsyth. Agricultural Experiment Station, University of Maryland, College Park, Maryland. How an owner values trees, "social psychology".

Wildland Recreation Use and Social Interaction. J. C. Hendee. USDA, Forestry Station, University of Washington, Seattle, Washington, Social characteristics of recreation users. Perspectives of wilderness users and wilderness managers.

Recreational Trail Use and User Characteristics in Michigan. M. Chubb. Michigan State University, East Lansing, Michigan.

A Systems Approach to Determination of Desire for Outdoor Recreation-Empaasizing "Need" Factor. T. B. Knopp. University of Minnesota, St. Paul, Minnesota.

Personality and Forest Recreation. H. S. Bhullar. Mississippi State University, State College, Mississippi. College age black and white users. Campus Attitudes and motivations.

Environmental Forestry. Brian R. Payne, Annual Report for Northeastern Forest Experiment Station Research Work, Amherst, Mass. Effect of outdoor recreation on aggression levels.

Shew, Richard Lee, PhD Thesis. Visitor Types in the National Parks: A Q-Study of Public Wants and Needs in Outdoor Recreation. The Ohio State University, 1970.

Wilson, George Thomas, 1961. An Analysis of Effective Practices Employed to Reduce Vandalism in Park, Recreation, and Combined Departments in American Cities of Over 50 Thousand Population. RE.D. Thesis, Indiana University, page 1064, in Volume 2204 of Dissertation Abstracts.

D. Researchable Problems:

1. What attitudes and levels of knowledge regarding conservation and land-use management exist among decision makers (legislators, councilmen, planning board members, employed urban planners) and opinion formers, (newspapermen, radio and TV reporters) in our urban centers? How was and is their knowledge acquired and their attitude formed?

2. What forces motivate a person to seek recreation in the out-of-doors and in forest land? What barriers prevent his participation to the extent he would like or what imagined barriers exist?

3. What levels of knowledge do city dwellers and suburbanites have of their degree of dependence upon the natural world, such as sources of water, means of waste disposal, wood for construction and paper, and clean air?

4. Are there forms of employment or service whereby young people can regularly participate in protection, cleanup. and management of outdoor areas in the vicinity of cities and in parks? Can such regular participation influence attitudes, kinds of use, vandalism acts, and later political and social attitudes?

5. What values, positive and negative, real and imagined, do young people associate with parks, forested areas, and other forms of open space? How do value levels differ from those of adults?

6. Can a complexity (sophistification) of land use practices add to greater public acceptance and public recognition of open space management than the simplification and uniformity which professional municipal land managers are apt to inject?

7. Can active research on a variety of nature trail techniques improve the educational impact of such trails?

8. To what extent can urban and suburban open space increase the frequency and intimacy of interpersonal relationships to reduce the phychological isolation which people adopt in a city environment?

16. INTEGRATION OF USES ON FOREST LANDS

A. Keywords: Multiple use, Joint costs, Joint benefits, External costs, conflicting uses, Managing conflict.

B. Current Research Projects:

Municipal Watersheds, Urban-Suburban Trees and Environment, and Correlating Watershed Research Results. H. W. Lull. USDA, N.E. Forest and Range Experiment Station, Upper Darby, Pennsylvania. Timber harvesting and recreation on municipal watersheds.

Informational and Structural Needs for Multiple-Use Planning on Public Forests. W. R. Bentley. Michigan State University, East Lansing, Michigan.

Management of Small Game and Deer Habitat in the Southern Alleghenies and Cumberland Plateau. J. D. Gill. Annual Report for Northeastern Forest Experiment Station, Morgantown, West Virginia. Arbitration tactics for deciding integration levels of timber and wildlife production.

C. Literature Citations:

Holscher, Clark E., 1970. European Experience in Integrated Management of Urban and Suburban Woodlands. In proceedings of Symposium on Trees and Forests in an Urbanizing Environment, University of Massachusetts, Cooperative Extension Service, August.

Reidel, C. H., 1970. Environmental Forestry: A Modest Proposal. (Ecology) J. Forestry 68(2):100-102, 104, February.

Stewart, D. J., 1970. Where Are We In The Multiple Use Picture?. Pulp Paper Magazine, Canada, 71(Sept. 4) (69-71).

D. Researchable Problems:

1. How should the principle of integrated use (multiple use) be stated economically for application in an urban environment?

2. Many more uses on one site may be involved on an urban than a rural area, e.g., residential housing, power generation and distribution, waste disposal, recreation, landscaping, screening, firewood or other products?

3. Must the fact that no single use can justify appropriation of high valued urban land defeat the possibility that the combination of uses can justify such use of high-valued land?

4. Can forest land, managed very intensively for products. (by thinnings, improvement cutting, periodic harvest, natural and artificial regeneration) receive sufficient additional effort to maintain aesthetic and recreational potential?

5. What special activities and management practices are necessary for multiple use management of municipal watersheds to permit protection of water purity but the attainment of other values also?

6. Can city forestry in the United States profit by intensive study of multiple use practices on European city forests such as those in Frankfurt, Germany; Helsinki, Finland; Zurich, Switzerland; and Oslo, Norway?

7. Can multiple use aspects of "greenbelts" be increased to add to their acceptability and wider use? Can their use for waste water disposal be combined with recreation and forest use? Can aesthetic appearance value be gained from waste water disposal areas which must be fenced from actual entry.

8. Can small patchwork mixtures of land uses be feasible with certain types of agriculture (truck crops) mixed with woodlands, brush, and open areas to fit highly diverse land ownership patterns? Is there Swedish background for this, (see Lockwood Conference)?

9. Are there possible programs of subsidy or tax abatement for private landowners in urban areas to encourage their contribution of public uses of their land?

17. LAND USE PLANNING AND CONTROL

A. Keywords: Land classification, Zoning, City planning, Regional planning, Easements, Legal restrictions, Building codes, Greenbelts, Land Ownership, Soil maps, Community forest

B. Current Research Projects:

Management Characteristics of Urban Forest Space. J. O. Lammi. Agricultural Experiment Station, University of North Carolina, Raleigh, North Carolina. Use quality classification of Urban land from air photos.

Development of Rhode Island Forested Lands. C. Gratto. Agricultural Experiment Station, University of Rhode Island, Kingston, Rhode Island. Public officials discussions on land use changes. Land use simulation exercise.

Processes Through Which Policies Regarding Forest and Other Open-Space Lands Are Currently Being Formed and Changed in the Northeastern Urban Fringe Areas. Consortium for Environmental Forestry, Yale University, New Haven, Connecticut.

Values of Specific Tracts of Forest Or Open Land Over a 20-Year Period in Selected Towns of Massachusetts. Northeastern Forest Experiment Station, U.S. Forest Service, University of Massachusetts.

C. Literature Citations:

American Institute of Planners Journal

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D. Researchable Problems:

1. Can the concept of development through time be injected into metropolitan area planning, especially for existing forest lands so that management practices can be adjusted for forest areas which must eventually serve other uses? (Is static land-use planning self defeating since a change in plan may sometimes lead to abandonment of the total plan?) Can a feedback systems approach of adaptable land-use planning be initiated?

2. Can a unit size of different land uses be logically defined such that the use of land tends to be ecologically self-sufficient? (Is there a minimum size of building lot, highway right-of-way width, park area, developed recreation site, that is set by the ability of that land to "reclycle" the wastes that the users of this land generate in air, water, or solid waste?)

3. Has a definitive long-term hisotry of any area been compiled which shows how rural enterprises have been disrupted by escalating real estate values and taxes? Can documentation be obtained for damaging public development enterprises justified by cost-benefit ratios in which aesthetic and nonmonetary losses have not been recognized?

4. Can we develop better methods for classifying land as to its potential use, being more comprehensive and imaginative in the range and potential uses?

5. How do we encourage, induce, or compel developers to arrange activities with relation to each other and to existing topography, soils, and geology? Can a more comprehensive system of restrictions and incentives be developed that combine planning, zoning, tax policy, easements, public ownership, into a single policy rather than trying to use each separately.

6. Can state or larger regions plan to set aside major forest green-strip areas to separate expanding metropolitan areas rather than letting these gradually coalesce?

7. Can the open space concept be made broader to include many nonresidential and nonbusiness uses which can be made aesthetically or ecologically acceptable, rather than being excluded completely; e.g., riding trails, ski areas, golf courses, playgrounds, airport buffer strips, highway buffer strips, municipal watersheds, military reservations, equipment storage areas, etc.?

8. Do we need a Federal designation of Suburban Forest commensurate with rural National Forest?

9. Should zoning regulations include a minimum size for subdivision of forested lands to regulate the scattered movement of residences into forested areas?

10. How can transportation and communication corridors be combined and moved closer so that railroads, highways, power lines, pipe lines, telephone lines, etc., do not each have to appropriate a new strip of forested or other open space?

11. How can permanent abandonment of areas in inner cities for regrowth of forest grass be facilitated? (Should this be a part of redevelopment plans?).

12. What attitudes exist among policy makers with regard to "planning", "long-range planning", and "controlled development"? Are these attitudes rational, sentimental, political, or traditional? What past errors in planning account for these attitudes?